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# The role of cognitive load in effective strategic issue management

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ABSTRACT

Firms have different ways of addressing issues emerging from outside their regular calendar-driven strategy processes. These practices tend to be unstructured, organization specific, and highly dependent on the characteristics of the strategic issues themselves. Building on three dimensions of cognitive load—intrinsic, germane, and extraneous cognitive load—we extend existing research on strategic issue management by showing how different team-level choices in strategic issue processing and organizational congestion interact in their effects on a firm's strategic issue management performance. Based on an in-depth analysis of all 92 strategic issue decisions in a large multinational firm during a three-year period, we find that organizational disturbances influence strategic issue initiation by top management, which in turn influences the quality of strategic issue management practices and subsequent performance outcomes. We conclude by providing recommendations for managers on how they can decrease the sensitivity of their companies' strategic issue systems to external disturbances.



## Introduction

Many organizations experience sudden, unexpected changes in their business environments due to, for example, the emergence of new types of competitors, disruptive technologies, or economic crises. Developing a capability for strategic issue management has been proposed as a potential solution for anticipating and dealing with such changes (Ansoff, 1980; Dutton and Duncan, 1987; Dutton and Ottensmeyer, 1987).

While there is an extensive body of research on strategic issue management (Dutton and Duncan, 1987; Dutton and Jackson, 1987; Julian and Ofori-Dankwa, 2008) and the cognitive underpinnings of organizational responses to external changes (Barr and Huff, 1997; Barr et al., 1992; George et al., 2006; Gregoire et al., 2010), prior research has tended to focus on individual strategic issues and their characteristics, such as the salience of a strategic issue (Bundy et al., 2013) or whether the issue is perceived as an opportunity or threat (Dutton and Jackson, 1987).

We extend this research by examining what occurs when multiple simultaneously co-occurring strategic issues must be managed in parallel. We contribute to strategy research by introducing cognitive load theory (c.f., Kirschner et al., 2009a;

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Sweller, 1988; Sweller et al., 1990) as a novel theoretical lens to examine what occurs in organizations when management must address multiple parallel strategic issues. We extend the existing strategy literature by conceptualizing the strategic issue management process as a learning process instead of a process of information collection and analysis. We find that conceptualization corresponds well with reality because strategic issues tend to be learning episodes not only for the individuals involved but also for the organization as a whole.

Based on an analysis of strategic issue processing in a Global Fortune 500 firm during a three-year period, we find that the crowding or "congestion" of the firm's strategic issue management system has a major effect on the firm's ability to respond to strategic issues. Our notion of "organizational congestion" contributes to an improved understanding of the dynamics associated with strategic issue management by building on two streams of literature: (1) research on cognitive load theory, which has previously been predominantly used in educational research (e.g., de Jong, 2010; Kirschner et al., 2009a, 2011a; Renkl et al., 2009), and (2) research on the effects of multilevel information-processing structures in strategic issue management (e.g., Corner et al., 1994; Thomas and McDaniel, 1990; Thomas et al., 1994; Thomas and Trevino, 1993).

We will next provide an overview of cognitive load theory and its development over time, followed by a brief review of prior research on strategic issue management. We then put forward our hypotheses and describe the research setting, methods, and measures. We conclude with a discussion of our findings and implications for future research.

## Theory and prior research

### *Cognitive load theory*

The core premise of cognitive load theory is that the working memory of an individual is limited (Sweller and Chandler, 1994). If a learning task requires more capacity than can be accommodated by an individual's working memory, an individual can experience cognitive overload (e.g., de Jong, 2010; Yun et al., 2010).

While the limitations of human cognitive capacity have been known for several decades (e.g., Miller, 1956), cognitive load theory is commonly regarded to have originated from studies in the 1970s in educational psychology focused on the effectiveness of student problem solving (Sweller, 1976, 1980). Early tests involved attempts to improve learning through means-ends analysis, i.e., identifying the goal state, possible sub-goal states, and the current state. Identifying the goal state did not, however, improve learning. Instead, students performed better when they were presented with goal-free problems without consideration of the end goal (Sweller et al., 1982). The concept of cognitive load was formulated at the end of the 1980s in recognition of the limitations of the working memory capacity of individuals (Sweller, 1988; Sweller et al., 1990).

The understanding of cognitive load was refined in the 1990s with a finer-grained distinction between intrinsic, extraneous, and germane cognitive load. Intrinsic cognitive load is caused by the nature of the subject matter or the natural complexity of the information processed. Extraneous cognitive load refers to the extra effort imposed by the format of the instruction, e.g., irrelevant or extra cognitive activities related to the instructional format (Chandler and Sweller, 1992; Sweller and Chandler, 1994). Germane cognitive load is caused by the active processes involved in interpreting, exemplifying, classifying, inferring, differentiating, and organizing information that is required by effortful learning aimed at schema construction (Chandler and Sweller, 1992; Sweller and Chandler, 1994).

These three types of cognitive load were linked to the notion of the human cognitive architecture, which consists of practically limitless long-term memory, limited working memory, and the learning mechanisms of schema acquisition and automation (Sweller and Chandler, 1994; Sweller et al., 1998). Schemata are defined in cognitive load theory, consistent with schema theory (e.g., Bartlett, 1932), as cognitive constructs that organize information according to the manner in which it will be processed (e.g., Sweller and Chandler, 1994; Sweller et al., 1998). They are stored in longer-term memory and are instrumental in reducing working memory load. Because schemata are processed either consciously or non-consciously, automation is seen to play a major role in schema construction by helping alleviate the cognitive load of working memory.

Although cognitive load theory has, over time, informed a number of important findings related to individual-level cognitive learning processes, including the split attention effect, the redundancy effect, and the expertise reversal effect (e.g., Chandler and Sweller, 1992; Kalyuga et al., 2003; Sweller, 2004), studies of collaborative learning have emerged only recently in research on cognitive load theory (e.g., Kirschner et al., 2009a, 2009b, 2011a). Collaborative learning studies have typically focused on either the individual-level or group-level outcomes of the learning process.

Compared to the individual-level learning process, an important characteristic of the collaborative learning process is the additional cognitive load caused by the coordination required in the interaction patterns between individuals (Kirschner et al., 2011b). This coordination requirement is similar to the coordination requirements of transactive memory systems (Ren and Argote, 2011; Wegner et al., 1985), a concept used in organizational learning literature to refer to a collective system that individuals in close relationships use to encode, store, and retrieve knowledge that has also recently been integrated in group-level extensions of cognitive load theory (Fraidin, 2004; Janssen et al., 2010; Kirschner et al., 2011b). While the division of a learning task among multiple persons can be used to alleviate the limitations of cognitive load capacity and improve performance, collaborative learning results in a new type of cognitive load (Fraidin, 2004; Janssen et al., 2010; Kirschner et al., 2011b).

Collaborative learning trades off some of the intrinsic cognitive load (i.e., the difficulty of the problem) for extraneous cognitive load (i.e., the complexity of the process). In some situations, this trade-off might be particularly desirable, for example, if the intrinsic cognitive load of the task is significant and the team members are particularly trained in

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communicating and coordinating with each other. Generally, however, since the different elements of cognitive load tend to be additive, empirical studies have tended to report inconclusive results regarding the effectiveness of learning in team settings (Kirschner et al., 2009a). However, recent studies suggest that the relative benefits of collaborative learning increase with the complexity of the learning task (Kirschner et al., 2011a, 2011b).

Finally, team efficiency in a learning task has also been found to depend on the instructional design that the team is part of. Recent military psychology research has found that incorporating advanced decision-support systems as part of instructional designs affects team cognitive efficiency (Johnston et al., 2013). The concept of team cognitive efficiency relates further to the research on team cognition and team integrative capacity (Salazar et al., 2012).

Since strategic issue management commonly involves teams or task forces, the difficulty of the analysis task, external conditions, coordination requirements, and team capabilities are at the core of strategic issue management processes. We will next briefly review strategic issue management research through the lens of cognitive load theory before proceeding to develop our hypotheses.

### *Cognitive load and strategic issue management*

Similar to cognitive load theory, strategic issue management research originated in the 1970s and 1980s. Ansoff (1980: 133) originally defined a *strategic issue* "as a forthcoming development, either inside or outside of the organization, which is likely to have an important impact on the ability of the enterprise to meet its objectives." According to Ansoff, a strategic issue is something that needs management's attention outside the calendar-driven strategic planning cycle to be able to respond to surprising events and, more important, weak signals (Ansoff, 1975, 1980).

Ansoff (1980: 134) was also the first to put forward the concept of the *strategic issue management system*, which he defined as "a systematic procedure for *early* identification and *fast* response to important trends and events both inside and outside an enterprise" (emphasis in the original). Dutton's early work extended Ansoff's process development work with a focus on strategic issue diagnosis (Dutton and Duncan, 1987; Dutton et al., 1983; Dutton and Ottensmeyer, 1987). During the same period, Daft and Weick (1984) studied the front end of issue management by focusing on the role of the organization and its interpretation of the external environment. Among other early contributions to strategic issue management systems, King (1982) describes strategic issue analysis as a collaborative method to address strategic issues as a part of strategic planning process. Similarly, Camillus and Datta (1991) contrasted strategic issue management with strategic planning and proposed that strategic issue management systems should be integrated with strategic planning to cope with turbulent environments.

When examining research on strategic issue management in the 1980s through the lens of cognitive load theory, the search for optimal organizational structures and processes for strategic issue management resembles early research on cognitive load theory at the individual level in the design of instruction processes (e.g., Stark et al., 1998; Sweller and Chandler, 1994). The purpose of this research was to maximize learning efficiency by reducing the extraneous cognitive load associated with context and inappropriate means of instruction.

Over time, however, the focus increasingly shifted to the characteristics of strategic issues to understand how strategic issues are categorized by managers as either opportunities or threats (e.g., Dutton and Jackson, 1987; Jackson and Dutton, 1988) and how uncertainty and feasibility affect the patterns of interest around strategic issues (Dutton and Webster, 1988). While Ansoff's research was mostly prescriptive and focused on providing normative advice on how organizational processes for strategic issue management should be developed to optimize performance, Dutton's research contributed to an improved understanding of the interaction of individual strategic issues and the organizational sensemaking processes associated with them.

The focus on the perceptual characteristics of issues and their effects on management's cognitive processes links to research on cognitive load and how the nature of the problem affects the cognitive load arising from the problem-solving process. In the strategic issue management literature, threats have been found to be more cognitively taxing for individuals, but they also tend lead to a higher momentum for action (e.g., George et al., 2006; Gilbert, 2006). The ambiguity of issues has been found to relate to more extensive information searches (Plambeck and Weber, 2009) and on the attention that an issue receives (Bundy et al., 2013).

Thus, research on the effects of the characteristics of strategic issues on the cognitive processes of individuals and teams resembles what has been observed in cognitive load theory, that is, (1) team intrinsic cognitive load due to the complexity of strategic issue (Leahy and Sweller, 2008), (2) team extraneous load due to external disturbances, and (3) team germane load due to the efforts required to be invested in the learning process. We will next develop these insights into our four main hypotheses.

## Hypotheses

Fig. 1 provides our model of how the intrinsic cognitive load, extraneous cognitive load, germane cognitive load, and instruction design of the strategic issue management team affect the quality of decisions in a strategic issue management system. We will develop the individual hypotheses in more detail in the following paragraphs.

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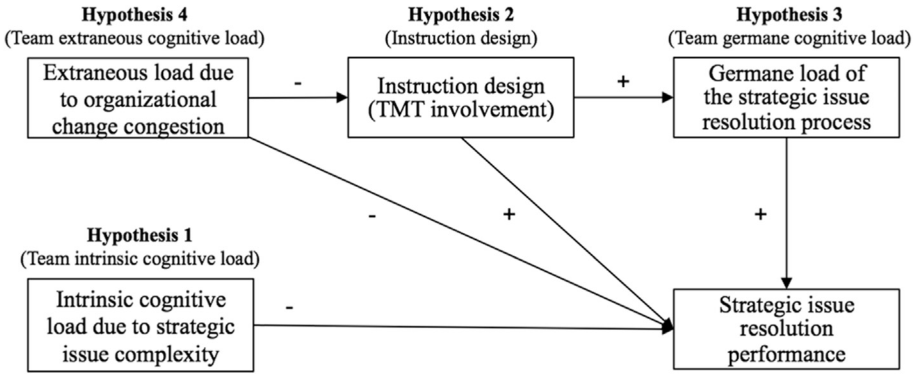


**Fig. 1.** Hypotheses on strategic issue team cognitive load and strategic issue resolution performance.

*Team intrinsic cognitive load*

According to cognitive load theory, intrinsic cognitive load is caused by the inherent difficulty of the learning task. The more complex the learning task with respect to the number of elements involved and their interdependencies, the more the learning task has been argued and found to cause intrinsic cognitive load. We extend this logic to the strategic issue management context. Our basic argument is that the more complex a strategic issue facing an organization, both in terms of its perceived uncertainty and the level of difficulty of implementation, the higher the strategic issue team intrinsic cognitive load that it causes.

External uncertainty requires an organization to learn about environmental contingencies to develop an understanding of external events and how external circumstances affect an organization's future. While there are generally a large number of potential information sources, an organization must search, categorize, and synthesize this information to form its own understanding. When this process is further combined with the intra-organizational challenges of determining the specific response to a strategic issue to optimize a firm's future performance, the number of interdependencies that must be understood to solve the strategic issue further increases the complexity of the learning task. Increases in cognitive load can be observed both at the individual level (e.g., the CEO) and in issue management task forces. While cognitive load theory has mostly focused on individual-level intrinsic cognitive load, intrinsic cognitive load has also been observed in teams that engage in problem-solving tasks. Extending the logic to strategic issue management teams, we hypothesize the following:

**Hypothesis 1**. *(Team intrinsic cognitive load). The complexity of a strategic issue is negatively related to strategic issue decision correctness.*

*Instruction design*

While intrinsic cognitive load is driven by the inherent characteristics of the learning task, it can be potentially reduced by an appropriate instruction design. In the strategic issue management context, the top management of a firm plays a key role in shaping the nature of an organization's response to strategic issues. Although many authors argue that middle managers tend to recognize strategic issues earlier than top management (e.g., McMullen et al., 2009; Wooldridge and Floyd, 1990), the attention provided by the top management is critical in establishing firm priorities according to which issues are processed and in providing the resources needed for issue analysis (Cho and Hambrick, 2006). By contrast, a lack of top management attention is likely to reduce focus and increase extraneous cognitive load.

Following this line of reasoning, McMullen et al. (2009) found that the detection of threats by competitive intelligence specialists does not correspond to the attention to those threats by top management. Because there are multiple demands for top management's attention, the cognitive effort allocated to emerging threats can become too small, and the threat can be forgotten. When top management allocates more time to an emerging threat, competitive considerations are also likely to affect their choices.

We focus on strategic issues identified and initiated by top management and the priority, resourcing, and outcomes given to these issues compared with other strategic issues emerging from middle management or elsewhere in the organization. We hypothesize that strategic issues that are identified and initiated by top management are likely to be given more capable learning resources. These resources are assigned to more experienced teams with a strong track record in handling strategic issues (i.e., positively evaluated solutions to prior strategic issues they have addressed). Such strategic issues are also likely to be given higher priority in issue management meetings. Thus, we expect top management-initiated issues to also contribute to higher issue management performance.

**Hypothesis 2**. *(Instruction design). Strategic issue initiation by top management is positively related to (a) the past issue management track record of the issue management team; (b) issue prioritization on the meeting agenda; and (c) issue decision correctness.*

### Team germane cognitive load

Germane cognitive load is the "positive" load caused by the efforts aimed at the development of schemata required by learning. When a strategic issue management team is developing its routines and schemata, it is likely to face a higher load than when it has reached a higher level of proficiency. Strategic issue management teams that have a history of good performance (positive evaluations of work on prior strategic issues) are likely to have developed routines that enable faster learning, even in connection with new strategic issues. They may have developed generic cognitive schemata that can be applied when engaging in a learning task in connection with new strategic issues. Accordingly, we argue that experienced teams that have already developed a track record of high decision accuracy also likely perform better on new issues since they do not have to expend as much (germane) cognitive effort to learn how to coordinate and collaborate in processing the strategic issues.

Furthermore, consistent with our hypothesis above on the effects of top management strategic issue initiation, we predict that issues prioritized in meetings on meeting agendas are resolved more accurately. They receive more attention and cognitive effort already in strategic issue management meetings, and due to the attention that the issues receive, the strategic issue management team's own learning requirements are also reduced.

**Hypothesis 3**. *(Team germane cognitive load). Strategic issue decision correctness is greater for issues that are (a) managed by teams with a good track record in past accuracy and (b) prioritized in a meeting.*

### Team extraneous cognitive load

Finally, extraneous cognitive load can be caused by outside disturbances that are not related to the learning task. Similarly, the attention-based view (Joseph and Ocasio, 2012; Ocasio, 1997) indicates that the context of organizational decision makers influences the attention that the decision makers can and will allocate to strategic issues. In the context of our study, the focal organization experienced a significant organizational change, which imposed a considerable additional workload on all management layers to reconfigure organizational processes and routines (Feldman, 2000, 2003; Feldman and Rafaeli, 2002) and re-establish consensus (Markoczy, 2001).

While prior research has not examined how a major organizational change and the associated cognitive stress affect successful strategic issue processing, other studies have investigated the potentially adverse consequences of organizational disruptions and limited attention allocation capacity. For example, Barnett and Freeman (2001) found that although new product introductions are generally positively related to a firm's subsequent performance, firms experience significant disruptions and an increased hazard of organizational failure when they simultaneously introduce multiple new products based on a new technology.

Thus, building on the basic premise that organizational attention is a scarce cognitive resource (e.g., Kahneman, 1973; Ocasio, 1997; Peng and Xiong, 2006), we hypothesize that the extraneous cognitive load caused by a major organizational change can limit the attention that top management can devote to identifying and initiating strategic issues outside the scope of the organizational change. Moreover, we predict that such organization-wide disruptions have direct negative effects on the correctness of strategic decisions.

**Hypothesis 4**. *(Team extraneous cognitive load). Organizational congestion reduces (a) the initiation of strategic issues by top management and (b) issue decision correctness.*

## Methods

### Empirical setting

To eliminate the potentially distracting influence of different information structures and issue-processing practices of different firms (e.g., Thomas and McDaniel, 1990), we chose to restrict our research setting to a large Global Fortune 500 firm. To ensure that we had a sufficiently large number of strategic issues to focus on, we chose a large firm in a dynamic business environment with a continuous stream of emerging issues. Thereby, we focused on a large globally operating technology firm, which had over 60,000 employees at the time of our study.

As the time frame of our analysis, we examined the evolution of the strategic issue management system from its implementation in 2000 to its termination in 2005 and chose three years, from the beginning of 2001 to the end of 2003, for a more in-depth quantitative analysis. During this time period, the technology sector in question grew rapidly in terms of technology diffusion. At the same time, however, there were significant changes to business logics, the emergence of new competitors, and a downward trend caused by the end of the Internet hype.

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Using a nested single-case design allowed for a rich description of the functionality of the strategic issue management system and helped explain the dynamics within the system. Because strategic issue management is frequently a fragmented process in organizations, the research process itself was a rather complex task, calling for an in-depth analysis of the system as a whole. We made sense of the different aspects of the case organization's strategic issue management system, its relationship with the annual strategic planning practices, and even the language that was used in the firm to label and refer to different matters. We next explain how the firm's strategic issue management system was developed and how it evolved over time.

*Case company's annual strategic planning process*

In the case company, a dedicated strategy unit at the corporate center was responsible for facilitating the corporate-level strategic planning process and supporting business strategy development. However, strategic planning was also performed in different business divisions. In this respect, the organization of strategic planning tasks in the case company was fractal-like. In addition to the corporate strategy unit, each business division had its own strategic planning function, and each level within each division had its own strategic planning staff, with guidance from the corporate unit.

The company followed an annual planning cycle to determine the overall focus of the corporation and its businesses as well as to assure coherence and cooperation between the divisions and units. The annual process focused on evolutionary rather than revolutionary changes. Strategic plans were implemented downward into more specific operational plans for all units and into employee-level target setting. At the beginning of our case study period, the emerging strategic issues for the company had been addressed on an ad hoc basis. However, over time, this approach was no longer considered sufficient, as the unpredictability in the business environment was increasing.

*Creation of the strategic issue management system*

The company executives realized that a more structured approach was needed to address the increasing number of strategic issues. The strategic issue management system in the company was implemented at the end of 2000, by the new head of corporate strategic planning. The company had an established process for making decisions on new business proposals, in which decisions regarding whether to allocate resources to the proposals were made in monthly meetings of the company's new business proposal board. However, as the volume of the new business proposals had decreased over time, there was discussion regarding the future purpose of the board, which consisted of 10–15 senior people throughout the company.

The company decided to utilize this board, whose regular meeting schedule was already aligned with the other meeting schedules of the company, but modified the board to address not only new business proposals but also the emerging strategic issues of the company. In total, 3/4 of the members of the board were changed to better reflect the decision-making needs of the company for strategic issues rather than for new business proposals. Senior executives made detailed preparations and held discussions to decide the best persons for the board. Additionally, the board was re-named the strategy board.

*Organization of the strategic issue management system*

The strategic issue management system of our case company consisted of three parts: the strategy board, the strategic issues themselves, and the task forces that were working on the issues. All the strategic issues of the company were addressed through the new system. In order for an issue to qualify as strategic, the issue had to have corporate-level importance and, thus, the issues were typically cross-divisional issues, issues that did not fall directly into a particular business division, or issues that merited corporate-level attention because of their importance.

The strategic issues were often complex and thus required the involvement of many viewpoints. When a strategic issue was identified, a network of people was activated as a task force to study the issue, and a list of potential responses was developed. The members of the task forces were employees with different roles in different parts of the organization who could be allocated to issue-driven task forces when a multiplicity of viewpoints was required.

The strategy board, within its monthly meetings, decided the schedule for the issue task force and made decisions based on the results of the task force's work and the resulting discussions of the board. Because of the time limitations of the meeting, the board was able to discuss a maximum of 3–4 strategic issues per month. A distinctive feature of the strategic issues (or issue themes) of the case company was that they commonly persisted over a long time period. Issues related to the same themes often reappeared on the board's agenda over time, even after several months of inactivity on the part of the board. An issue theme could have been dormant for several months but then activated again as an issue requiring a new decision depending on the demands of the company's external situation. Alternatively, a task force's work may have taken longer than expected to provide appropriate recommendations.

*The effect of congestion on the strategic issue management system*

One key event for our case company occurred when the company announced a major reorganization in September 2003, a change that would take effect in the beginning of 2004. Although the company had previously undergone numerous organizational changes, this change was atypical for the company because the announcement did not include details regarding the reorganization and because a large time gap was allowed between the announcement and the effective date for the reorganization.

The reorganization had been devised within a small group, but once the reorganization was announced to the entire organization, organization-wide task forces were established to redesign the organization. The guiding principle was that

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practically every employee within the organization would be affected by the change. The reorganization abolished the previous business division structure and implemented a new matrix-like structure, which necessitated that all organizational processes be redesigned. The implication of the reorganization for the key people in the organization during the fall of 2003 was that they were consumed by designing the new organization while executing the current company strategy, as the company strategy had not been altered. Thus, the key people had less time to devote to the strategic issues the company was facing because they had to spend more time developing their new positions and teams within the new organization. The following quote clearly illustrates this challenge: "*The top management's attention shifted to designing the new organization, and they hardly had any time left for the strategic issues. Strategic issues were kind of on autopilot. The key reason for this was how the change was executed, i.e., announcing it first and then designing the new organization through extensive organization-wide task forces.*" (*Head of Strategic Planning).*

The organizational change was ultimately prioritized in everyone's agendas over longer-term strategic issues with long-term implications. More participants excused themselves from the strategy board meetings, and in one instance, a meeting of the strategy board had to be canceled because there was no time to discuss the topics or prepare the topics for discussion. Moreover, in the remaining meetings during that year, some of the key strategic issues were dropped from the meeting agendas and were replaced by less important issues that nevertheless filled the meeting agendas. The organizational congestion was also clearly evident in the e-mail archives of the head of strategic planning, as shown in Fig. 2. The volume of e-mails related to strategic planning began to decline rapidly before the announcement and remained low during the fall when the new organization was being developed. The participation in strategy board meetings also declined to its all-time lowest level in the last quarter of 2003.

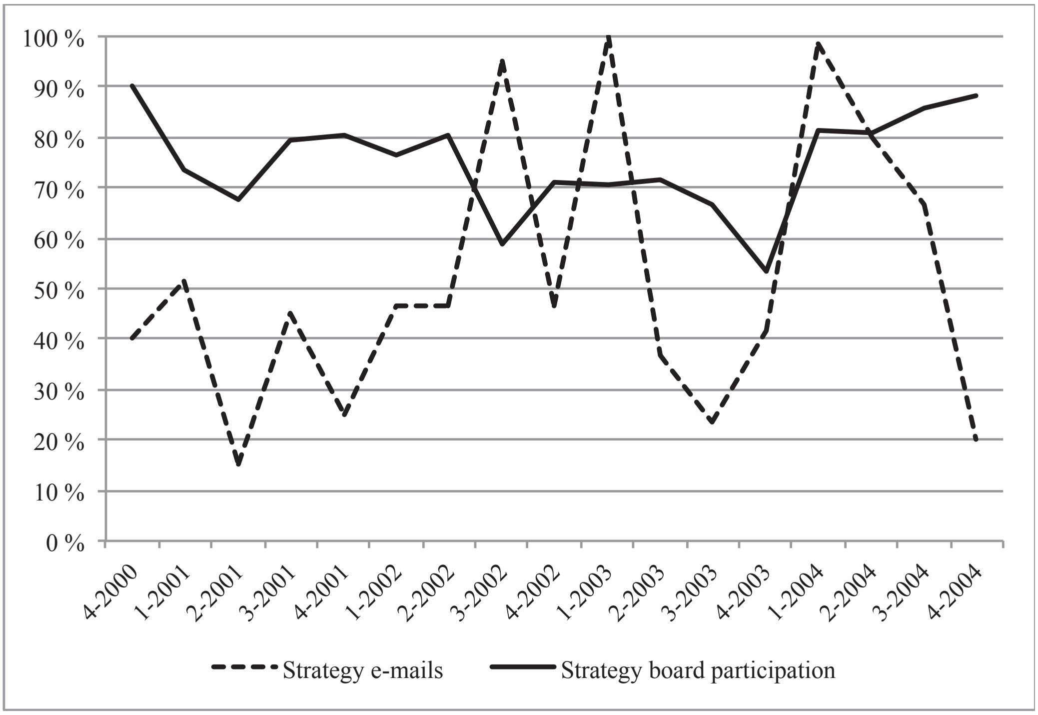


**Fig. 2.** Organizational congestion over time during 2000–2004. Quarterly archived e-mail volume (index) of strategy related e-mails for the head of strategic planning and participation rate in strategy board meetings.

*Data collection*

The case firm's strategy board processed and made decisions on 92 strategic issues (all of them documented in meeting minutes as separate decisions) during the time period of our study, 2001–2003.[1] Two researchers of our four-researcher team were granted access to management meeting presentations and minutes as well as various working documents that pertained to the evolution of strategic issues. For each issue, we went back to the emergence of the issue to review management's

[1] Although the 92 strategic issues were related to a smaller number of themes, each of the 92 issue decisions here are separate decisions (as documented in the meeting minutes), allowing them to be analyzed quantitatively. As an additional robustness test, we reran the regression analyses by clustering the standard errors by theme with qualitatively similar results.

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originally documented perceptions of its importance, its complexity, and numerous other issue characteristics. We tracked the processing and the ex post consequences of each issue in detail. Our research team spent hundreds of hours during the 2003–2007 period on different tasks, tracking and analyzing the issues and searching for ways to quantify their different characteristics.

Although there have been analyses of firms' strategic issue management systems (Camillus and Datta, 1991; Dutton et al., 1983; Oomens and van den Bosch, 1999), to our knowledge, no studies have gone to a similar depth in analyzing a global firm's strategic issue-processing practices. As external researchers, we would most likely never have gained such in-depth access to the central nervous system of a large firm, but because two of our research team members were working in the case company's corporate planning unit, we had unrestricted access to all the internal materials and discussions concerning all the issues that had been processed during the period of our analysis. At the same time, however, as these persons were important actors in the issue management process, we had to take a number of precautions to ensure that the measures were non-biased.

First, these persons were involved in managing the overall issue management process, not individual issues, which enabled them to evaluate all processed issues without potential biases stemming from their own involvement in an issue. Second, we also reduced the potential subjectivity bias by having two internal people involved in the analysis process crosscheck each other's ratings. Third, the issues were discussed among both internal and external members of the research team, and the ratings were debated and compared with the descriptions of the strategic issue histories. In addition to these subjectivity checks, we developed several alternative measures for the different issue characteristics and emphasized measures that could also be quantified ex post. The potential threat of common method bias was also lowered because many of the variables were based on facts obtained from the archival material (e.g., based on text analysis of the meeting minutes), the key independent variable organizational congestion was measured separately at a different level (a monthly measure at the organizational level), and the key dependent variables were measured ex post years after the issue decisions.

*Measures: dependent variable*

*Issue decision correctness*

As our main dependent variable, we use the strategy board's decision quality measured ex post at the issue level. Given that there are no available objective measures for strategic issue decision quality and that such measures cannot be credibly inferred from any data such as company market value development, we chose to operationalize this variable based on ratings by two experts in the company who had participated in the strategic issue management process over the sample period. They rated all the issues on a five-point scale of [2, correct; 1, somewhat correct; 0, neutral; −1, somewhat wrong; −2, wrong]. The coding was based on ex post knowledge of the research team of what had occurred four years after the decision. We needed this temporal lag to benefit from the hindsight—at the time of decision making, all decisions were generally perceived as correct ones. Determining the performance of strategic issue processing on an individual decision level in any other way would be difficult because although one can clearly distinguish between successful and unsuccessful decisions, alternative histories do not exist. Thus, it is difficult to determine whether other decisions would have been even more successful or would have led to even worse outcomes. Moreover, many decisions were relatively neutral and thus could not be classified as clearly successful or unsuccessful decisions. Additionally, from a practical point of view, being able to distinguish between small and large successes and failures is important. Although there are obvious limitations in the reliability of decision correctness measures based on ratings by experts, using two insider experts who were involved in the management of the corporate-level strategic issue management process but not directly involvement in individual issues was considered the best alternative for creating a measure for strategic issue correctness.

*Measures: independent and issue process-level control variables*

*Issue complexity* was defined as a perceptual measure on a three-point scale of [1, 2, 3] measuring the magnitude of challenges related to the issue. Accordingly, 1 corresponded to a situation in which the prevailing structures did not restrain the implementation of a solution to the issue, 2 corresponded to a situation in which the prevailing structures and assets posed a barrier to the implementation of a solution, and 3 corresponded to a situation in which implementing a solution to the issue was regarded as being highly challenging.

*Top management issue initiation* was operationalized based on archival data based on whether the issue was raised by the top management directly as opposed to, for example, being escalated from a business division or spun off from the annual planning cycle. This variable was coded with a binary scale of [0, 1], where 1 corresponded to the source being the top management.

*Issue team accuracy track record* was measured by calculating for each individual involved in the issue management a dynamic personal track record as an average of the ex post correctness of the decisions that they had been involved in before the focal issue. For each issue, the past track records of the issue team were averaged. If a track record did not exist for any of the team members, a zero was imputed. The sensitivity of our results to this imputation process was tested in separate robustness tests by including a dummy variable, which was not significant.

*Issue prioritization on the meeting agenda* was measured as a dummy variable [0, 1], taking the value 1 if the issue was not placed last on the meeting agenda. The 92 issues in the sample consisted of, on average, 3.1 issues handled in 30 meetings. In meetings with a pre-set duration in this setting, the last item on the agenda was most likely to receive inadequate time and attention. The meeting agenda was always carefully thought-out and decided well before each meeting, i.e., which topics, in which order, and how much time allocated to each topic.

*Organizational congestion* was operationalized on a monthly level using a significant organizational change (company-wide restructuring) in the case company as a measure of external load to the issue management system. An ordinal variable with values of [0, 1, 2] was operationalized to measure the level of organizational congestion caused by the restructuring on a monthly level based on the ratings of the two managers involved in the process as well as a review of e-mail and other archives and interviews of other stakeholders in the organizational change and strategic issue management processes. The variable was assigned a value of 2 for the most intensive months of a major organizational change, 1 for moderate intensity months, and 0 for months without change. As further validation of the relevance of this organizational congestion measure, we found that it had a 0.40 correlation with absences of members of the strategy board. Moreover, one of the authors of the article had access to the e-mails of the person acting as the secretary of the strategy board, which allowed us to triangulate the measure and confirm that the monthly volume of e-mails coincided with our measure of organizational congestion.

*Issue-level control variables: Issue value at stake.* The perceived value at stake of a strategic issue was determined based on a comparison of the estimated impact of the issue on the market capitalization of the firm using a scale with values of [0.25, 2.5, 7.5], where the values correspond to a value impact between [0%, 0.5%] for the firm's market capitalization, between [0.5%, 5%] for the firm's market capitalization, and between [5%, 10%] for the firm's market capitalization, respectively. Relative instead of absolute value at stake was used because it better reflects the relative importance of a given decision vis-à-vis other decisions and does not need to be recalibrated over time. Stated differently, the relative classification considers the decision within the decision-making context of the management in the particular company.

*Issue perceived as an opportunity/threat* measures the framing of the issue in the meeting minutes either as an opportunity or as a threat using two dummy variables coded as [0, 1]. This approach is consistent with prior work in which these phenomena are viewed as two separate constructs rather than the ends of one dimension (e.g., Oomens and van den Bosch, 1999). We performed the coding based on a text analysis of the strategy board's meeting notes. We determined the 20 most common words that were used to document the board's discussion on strategic issues and then coded each issue according to a 20-item vector corresponding to these 20 words. Excluding articles and prepositions, 20 words were found to provide a sufficiently fine-grained categorization that enabled us to distinguish between different ways in which management made sense of different types of strategic issues.

## Results

Table 1 provides the descriptive statistics and correlations of our measures. The highest positive correlations are found between *Issue value at stake* and *Issue prioritization on the meeting agenda* (0.40) and between *Top management issue initiation* and *Issue team accuracy track record* (0.39). This latter correlation is particularly interesting because it would seem to imply that when the top management initiates a strategic issue, the issue team tends to be systematically staffed with better-qualified issue team members. We also see that *Issue value at stake* is positively correlated with *Top management issue initiation* (0.31) and with *Issue perceived as an opportunity* (0.29). Furthermore, *Issue decision correctness* is significantly positively correlated with *Issue team accuracy track record* (0.28). We find the strongest negative correlations between *Organizational congestion* and *Issue decision correctness* (−0.25). This relationship provides tentative support for our hypotheses. Moreover, *Organizational congestion* is negatively related to *Top management issue initiation* (−0.21); this result also seems consistent with our predictions regarding organizational congestion. Because all the correlations that are shown in Table 1 are far below the 0.70 multicollinearity threshold (Nunnally, 1978), we do not anticipate problems with multicollinearity in our analyses.

**Table 1**
Descriptive statistics and correlations.[a]

| | Variable | Mean | s.d. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Issue decision correctness | 1.21 | 0.92 | | | | | | | | |
| 2 | Issue complexity | 1.59 | 0.50 | −0.20 | | | | | | | |
| 3 | Top management issue initiation | 0.63 | 0.49 | 0.12 | −0.09 | | | | | | |
| 4 | Issue team accuracy track record | 0.91 | 0.90 | 0.28* | −0.13 | 0.39* | | | | | |
| 5 | Issue prioritization on the meeting agenda | 0.67 | 0.47 | 0.16 | 0.03 | −0.10 | −0.01 | | | | |
| 6 | Organizational congestion | 0.35 | 0.65 | −0.25* | −0.09 | −0.21* | −0.08 | 0.02 | | | |
| 7 | Issue value at stake | 3.42 | 2.94 | 0.11 | −0.15 | 0.31* | 0.18 | 0.40* | 0.00 | | |
| 8 | Issue perceived as an opportunity | 0.07 | 0.25 | −0.16 | −0.05 | −0.07 | 0.01 | 0.09 | 0.13 | 0.29* | |
| 9 | Issue perceived as a threat | 0.07 | 0.25 | 0.04 | 0.13 | 0.02 | 0.07 | −0.19 | −0.01 | 0.00 | 0.11 |

[a] *$p < 0.05$.

Fig. 3 provides the results from a path analysis conducted with Mplus Version 7.11 (Muthén and Muthén, 2012), which can be used for an analysis of categorical dependent variables (in our robustness tests, we test the hypotheses using alternative methods with similar results). The model is estimated using the Mplus default estimator (a robust weighted least squares

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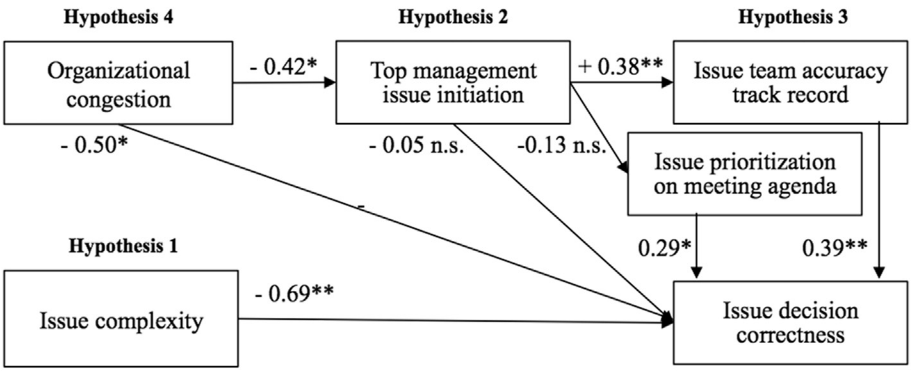
estimator) for this model with Theta parameterization instead of the Delta parameterization to enable an estimation of a model with continuous, binary, and ordinal response variables. The sample of 92 is small but still has more than 15 observations per estimated parameter (6 parameters), well above the common rule of thumb of 10 for an acceptable model (Klein, 2011). The fit of the hypothesized model is excellent, with a comparative fit index (CFI) of 1.000 (the suggested threshold for a good fit is CFI $>$ 0.95 (Hu and Bentler, 1999)), a root mean square error of approximation (RMSEA) of 0.00 (the suggested threshold for a good fit is RMSEA $<$ 0.07 (Steiger, 2007)), and a weighted root mean square residual (WRMR) of 0.41 (the suggested threshold for a good fit is WRMR $<$ 1.00).




Hypothesized model estimated using Mplus Version 7.11 (Muthén and Muthén, 2012). ** p < .01, * p < .05, + p < .10; one-tailed tests. Model fit indices: CFI = 1.00, RMSEA = .00, WRMR = .46.

**Fig. 3.** Results of the hypothesis tests.

In Hypothesis 1, we predicted that the complexity of a strategic issue is negatively related to strategic issue decision correctness. This prediction is supported by our results. Fig. 3 shows that the complexity of the strategic issue is significantly negatively related to the issue decision correctness ($b = -0.69$, $p < 0.01$).

In Hypothesis 2, we predicted that strategic issue initiation by top management is positively related to (a) the past issue management track record of the assigned issue management task force, (b) issue prioritization on the issue meeting agenda, and (c) strategic issue decision correctness. We find that *Top management issue initiation* is statistically significantly positively related to *Issue team accuracy track record* ($b = 0.38$, $p < 0.01$). However, the predicted relationships with *Issue prioritization on the meeting agenda* (Hypothesis 2b) and *Issue decision correctness* (Hypothesis 2c) are not statistically significant and thus are not supported in this analysis.

In Hypothesis 3, we predicted that strategic decision correctness is higher for strategic issues that are (a) managed by teams with a good track record in past accuracy and (b) prioritized in strategy board meetings. Consistent with these predictions, we find that *Issue team accuracy track record* is positively related to *Issue decision correctness* ($b = 0.39$, $p < 0.01$) and that *Issue prioritization on the meeting agenda* is positively related to *Issue decision correctness* ($b = 0.29$, $p < 0.05$). Thus, Hypothesis 3 is also supported by our analyses.

Finally, in Hypothesis 4, we predicted that organizational congestion (a) reduces issue initiation by top management and (b) reduces the issue decision correctness. Both predictions are supported by our results. We find that *Organizational congestion* is statistically significantly negatively related to *Top management issue initiation* ($b = -0.42$, $p < 0.05$) and *Issue decision correctness* ($b = -0.50$, $p < 0.05$).

Collectively, the results reported in Fig. 3 provide support for our multilevel hypotheses on the effects of different types of team-level cognitive load on the effectiveness of strategic issue management. The only predictions that do not receive support from our path analysis are the predicted effects of top management's strategic issue initiation on the prioritization of the strategic issue on the strategic issue management meeting agenda and on the issue decision correctness.

*Robustness tests*

To ensure the robustness of our results, we reran a number of robustness checks to test alternative operationalizations and model specifications. For instance, instead of the Mplus default estimator for this model (robust weighted least squares estimator), we reran the model using an alternative maximum likelihood estimator obtaining similar results in the hypothesis tests. To ensure the robustness of our findings, we also tested an alternative measure of intrinsic cognitive load based on the uncertainty of the strategic issue defined as a perceptual measure on a three-point scale of [1,2,3], where 1 corresponded to a lack of information that could be easily reduced through additional information collection, 2 corresponded to a lack of knowledge where such information could be gained, and 3 corresponded to a more fundamental inability to predict what is going to happen. Using this alternative measure, the results of all our hypothesis tests remained qualitatively similar to those reported in Fig. 3, with the relation between the issue uncertainty and issue decision correctness being slightly more significant than the relation between the issue complexity and issue decision correctness in the original model.

To ensure the results were not driven by the Mplus model specification, we reran the hypothesis tests using Stata's novel generalized structural equation model estimation command (GSEM), which, similar to Mplus, also allows consistent estimation of categorical response variables. Some drawbacks of the current version of GSEM include the lack of model fit statistics, lack of standardized coefficients and the capability to estimate the model using only the maximum likelihood estimator. However, despite these drawbacks, the estimation results shown in Model 2 in Table 2 show that the results of the hypothesis tests are highly consistent with those of the Mplus results reported in Model 1.

**Table 2**
Path model and regression analyses.[a]

| Variable | Issue decision correctness | | | Issue team accuracy track record | | | Issue prioritization on the meeting agenda | | | Top management issue initiation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3a | Model 1 | Model 2 | Model 3b | Model 1 | Model 2 | Model 3c | Model 1 | Model 2 | Model 3d |
| | Path model | Path model | Ordered logit | Path model | Path model | OLS | Path model | Path model | Logit | Path model | Path model | Logit |
| Issue complexity | −0.69** | −1.14* | −1.21** | | | | | | | | | |
| | (0.29) | (0.51) | (0.51) | | | | | | | | | |
| Top management issue initiation | −0.05 | −0.18 | −0.18 | 0.38** | 0.73** | 0.69** | −0.13 | −0.46 | −1.31** | | | |
| | (0.18) | (0.46) | (0.54) | (0.16) | (0.18) | (0.20) | (0.17) | (0.48) | (0.53) | | | |
| Issue team accuracy track record | 0.39** | 0.60** | 0.58* | | | | | | | | | |
| | (0.16) | (0.26) | (0.25) | | | | | | | | | |
| Issue prioritization on the meeting agenda | 0.29* | 0.76+ | 0.88+ | | | | | | | | | |
| | (0.15) | (0.50) | (0.54) | | | | | | | | | |
| Organizational congestion | −0.50* | −0.87** | −0.83** | | | | | | | −0.42* | −0.66* | −0.69* |
| | (0.27) | (0.27) | (0.28) | | | | | | | (0.20) | (0.36) | (0.37) |
| Issue value at stake | | | −0.00 | | | 0.02 | | | 0.50** | | | 0.33** |
| | | | (0.09) | | | (0.03) | | | (0.14) | | | (0.10) |
| Issue perceived as an opportunity | | | −1.18 | | | 0.03 | | | −0.59 | | | −1.70 |
| | | | (1.10) | | | (0.37) | | | (1.65) | | | (1.06) |
| Issue perceived as a threat | | | 0.62 | | | 0.22 | | | −1.99* | | | 0.36 |
| | | | (0.90) | | | (0.24) | | | (0.85) | | | (1.23) |
| Constant | | | | | | 0.39** | | | 0.34 | | | −0.11 |
| | | | | | | (0.16) | | | (0.45) | | | (0.35) |
| Observations | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| $R^2$/Pseudo $R^2$ | | | 0.11 | | | 0.16 | | | 0.23 | | | 0.14 |

[a] Model 1 is a path model estimated using the Mplus estimator for categorical dependent variables (standardized coefficients). Model 2 is a path model estimated using Stata's generalized structural equation model estimation command (GSEM) with the paths specified as ordered logit regression, OLS regression, or logit regression depending on the response variable and estimated with robust standard errors. Models 2a–2d are separate regressions using Stata (Model 2a ordered logit regression, Model 2b OLS regression, and Models 2c and 2d logit regression) with robust standard errors.$^{**}p < 0.01$,$^{*}p < 0.05$, $+p < 0.10$. One-tailed tests for hypothesized relationships; two-tailed tests for controls.

In addition, given the small sample size, we reran our hypothesis tests using separate ordered logit, logit, and OLS regression models (depending on the dependent variable) as a robustness test (Models 3a–d in Table 2). These analyses enabled us to control for the influence of strategic issue characteristics. We controlled for *Issue value at stake* (e.g., Dutton et al., 1989), which was strongly positively related to *Issue prioritization* and *Top management issue initiation* but did not alter the results reported above. We also controlled for the framing of the issue either as an opportunity or as a threat (e.g., Jackson and Dutton, 1988). *Issue perceived as an opportunity* was not significantly related to any other variable, whereas *Issue perceived as a threat* was significantly negatively related to *Issue prioritization on the meeting agenda*. The results of these supplementary regression analyses are provided in Table 2. In additional unreported robustness analyses, we also reran these analyses using standard errors clustered by strategic issue theme with generally consistent results.

## Discussion

Anticipating and responding to emerging issues are at the heart of a corporation's ability to overcome sudden unexpected developments in its business environment (Ansoff, 1975, 1980). By making timely adjustments to a corporation's strategy, top management can enhance the firm's competitive advantage. There are, however, numerous examples of companies that have failed to respond to strategic issues either because they failed to identify the issue as it was emerging or because they were unable to effectively determine the optimal response. We contribute to research on strategic issue management by further opening up the black box of strategic issue management systems. Our study is one of the few studies to empirically examine strategic issue management practices and their outcomes using detailed internal data on the performance of strategic issue management decisions in a large global corporation. While prior research on strategic issue management has tended to focus

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on individual issues and their characteristics, we show that it is important to understand how multiple strategic issues interact in an organization when they compete for the limited attention of the top management, strategy board team members, and the most capable strategic issue management task force members.

*Contributions to theory*

*Cognitive load theory*

In addition to extending strategic issue management research from a focus on individual strategic issues to the management of multiple simultaneous strategic issues, we introduce a novel theoretical lens for understanding the dynamics of different types of strategic issue team-level cognitive load. We conceptualize the strategic issue management process as a learning process instead of a simple process of information collection and analysis. For a strategic issue management team to develop an in-depth understanding of the implications of a strategic issue for an organization, they must engage in a learning process to understand the nature and implications of a new business opportunity or threat. We therefore can apply in strategic issue management research insights from the cognitive load theory developed in educational psychology (Chandler and Sweller, 1991; Johnston et al., 2013; Paas et al., 2004; Sweller and Chandler, 1991; van Merrienboer and Sweller, 2005).

We extend in our paper the notions of intrinsic, extrinsic, and germane cognitive load to the strategic issue management team context. Accordingly, strategic issue team intrinsic cognitive load corresponds to the nature and characteristics of the strategic issue itself, e.g., the substantive complexity of the strategic issue. Strategic issue team extraneous cognitive load corresponds to additional cognitive activities arising from an inappropriate organizational setting or external disturbances for strategic issue management, which could result in cognitive strain coming from outside the strategic issue domain. Finally, strategic issue team germane cognitive load relates to the nature of the process with which the strategic issues are actively processed. These different dimensions of cognitive load help us better identify and separate the different types of cognitive loads experienced by the strategic issue management teams and propose different corrective actions to further enhance a team's strategic issue-processing capacity. While cognitive load theory has previously predominantly been applied in educational psychology at the individual level and only more recently also to collaborative team-level learning tasks (Janssen et al., 2010; Johnston et al., 2013; Kirschner et al., 2009a, 2009b, 2011a), our paper contributes to an improved understanding of how cognitive load relates to the information-processing structures of top management and how the individual and team levels interact (e.g., Corner et al., 1994; Kirschner et al., 2009a; Thomas et al., 1993; Thomas and McDaniel, 1990).

By introducing and applying cognitive load theory in the context of strategic issue management, our paper contributes to related streams of management research that have used similar or closely related concepts. For instance, Cramton (2001) used the concept of cognitive load to examine failures in developing mutual knowledge in geographically dispersed teams and whether the cognitive load of individuals affects how they attribute failures of collaboration. In this inductive study, Cramton (2001) recognized the importance of cognitive load but did not link the concept to cognitive load theory. To examine the effects of managing simultaneous activities on performance, Castellaneta and Zollo (2015) applied a related concept, activity load, to test the effects of activity load in private equity firms, as measured by the number of concurrently handled investments, on the performance of the private equity firm.

As one of the very first studies to explicitly build on cognitive load theory, Haas et al. (2015) examined how individuals choose to allocate their attention to different problems in organizations. They found that in addition to the expertise and problem length, breadth and novelty, also “problem crowding”, that is, the number of concurrently occurring problems, affects how knowledge providers choose to allocate their attention to the problems. In another recent paper, Healey et al. (2015) theorized that cognitive load affects intra-team coordination in decision making. Acknowledging these prior contributions and the recent development and applications of cognitive load theory at the group level in collaborative learning (Kirschner et al., 2009a, 2011a), our paper adds to the existing literature as the first study to apply cognitive load theory in the context of strategic issue management. We thus contribute to an improved understanding of the potential benefits of the application of cognitive load theory in situations in which dispersed collaboration, complex problems, or high levels of activity may cause cognitive load that potentially affects performance.

*Attention-based view*

Our paper also adds to the body of research applying the attention-based view of Ocasio (1997) in the strategic issue management context (see, also Barreto and Patient, 2013; Bundy et al., 2013; Stevens et al., 2015). In particular, we contribute to an improved understanding of the structural distribution of attention through a strategic issue management system. While the structural distribution of attention was one of the key ideas of Ocasio's (1997) pioneering article, research on this aspect of attention is surprisingly limited. Ocasio's subsequent work demonstrates the power of this structural perspective in illustrating how the structural channels of attention at General Electric affected the emergence and evolution of strategy over time (Ocasio, 1997; Ocasio and Joseph, 2006). Similarly, the analyses of Novo Nordisk by Rerup (2009) and the Greek government by Jacobides (2007) have demonstrated the importance of understanding the structural distribution of attention.

Our findings contribute to an improved understanding of the attention-based view by showing that system-wide organizational congestion can constrain the attention of top management in strategic issue initiation and thus influence the functioning of the entire system. Moreover, our paper demonstrates the importance of the availability of capable strategic issue management team members for successful strategic issue processing. Although the attention-based view and cognitive load theory appear, in some respects, to be parallel theoretical lenses for studying organizational issue processing, we consider them complementary. As the attention-based view emphasizes the importance of attention and attention structures, cognitive load theory places the emphasis on the information-processing load caused by both external and internal strategic issues and their processing capacity requirements for the system.

*Limitations and avenues for future research*

Strategic surprises are “events that happen unexpectedly or expected events that take an unexpected shape” (Pina e Cunha et al., 2005). The key defining variables of surprises are the “(un)expectedness” of the issue and the “(un)expectedness” of the process. While this research stream focuses on deepening our understanding of why organizations become surprised (Lampel and Shapira, 2001), we also see major future opportunities in studying practices for managing responses to strategic surprises. If surprises are difficult to predict, then the second-best option is to develop capabilities for coping with surprises.

One limitation of our study is that it focuses on strategic issues in one large firm because comprehensive access to strategic issues and their management in large firms is very difficult to arrange. Therefore, practically no prior studies have systematically analyzed strategic issue management practices and their outcomes, but the focus on one firm obviously limits the generalizability of the findings. The resulting small sample size also sets limitations for the quantitative analyses. Future studies should attempt to access and analyze strategic issue management in additional firms to help generalize our findings about strategic issue management practices and their outcomes. In the measurement of strategic issue decision accuracy, we had to rely on ex post rating by two insiders involved in managing the strategic issue management process. Future research could develop alternative measures for strategic issue management performance. Given the long time span of many strategic issues and potential feedback from past strategic issue decisions to new strategic issues, more longitudinal research on strategic issue management practices and outcomes would also be very valuable.

Consistent with the call for further research by Hutzschenreuter and Kleindienst (2006), we see major potential in integrative work between the different streams of strategy process research. In addition to the research streams focusing on strategic issue management, organizational attention allocation, and cognitive load, there is also potential in linking research on organizational cognition more generally to research on strategic issue management, an area that has already started to receive increasing attention in recent years (Bundy et al., 2013; Gregoire et al., 2010; Marcel et al., 2011; Nadkarni and Barr, 2008; van der Steen, 2016). In particular, we see important parallels between the effects of organizational congestion on the collapse of organizational issue management processing and prior research on the collapse of organizational sensemaking (Christianson et al., 2009; Weick, 1993).

Moreover, we see abundant potential in the use of cognitive load theory more broadly to explain different phenomena occurring in organizations. Cognitive load theory focuses on the capacity of an individual to address multiple simultaneous demands cognitively. The core premise of cognitive load theory is that the working memory of an individual is limited (Sweller and Chandler, 1994). If a learning task requires more resources than an individual's working memory capacity, an individual can experience cognitive overload (e.g., de Jong, 2010; Yun et al., 2010). Such overload could also potentially be observed outside the strategic issue management system in top management teams when an organization is facing a crisis.

Finally, we find that the threat and opportunity labels play a surprisingly insignificant role compared with the otherwise prominent role that they have had in the strategic issue management literature (e.g., Jackson and Dutton, 1988; Julian and Ofori-Dankwa, 2008; Schneider and Demeyer, 1991). Our recognition of the central importance of the changing nature of issue categorization is consistent with recent literature that has found that the amount of information collection is related to changes in threat and opportunity perceptions (Anderson and Nichols, 2007) and that the ambivalence of CEOs' strategic issue interpretation is related to the amount of work that the CEOs are willing to devote to clarifying the strategic issue (Plambeck and Weber, 2009).

*Managerial implications*

As a tangible implication for management, we find that the staffing of the strategy issue management team plays an important role from the perspective of decision correctness. Thus, it is particularly important for companies to consider how to continuously develop the capabilities of their strategic issue management teams and to have the best resources on these teams.

While it should not be surprising to management that a major organization change can reduce an organization's sensitivity to unexpected external strategic issues, the way the strategic issue management system was configured in the case company made it particularly vulnerable to such an effect. In particular, the strategic issue management system relied on task forces that were composed of members of the top management team and strategic planning officers from different divisions. When these members became occupied by more urgent, shorter-term issues, the strategic issue management teams were deprived of resources.

Thus, if a company undertakes a major organizational change, it should preferably not have important strategic issues pending that require timely action or, at a minimum, should ensure that there continues to be sufficient dedicated resources for managing the strategic issue management system. Paradoxically, although a major organizational change is often considered a response to strategic challenges, if a company is continuously undergoing organizational change, such change may impair the company's ability to identify and undertake proper responses to the emerging strategic issues that it faces. The organizational congestion induced by major organizational change can be fatal if a company is faced with multiple emerging strategic issues, which is common in high-velocity environments. For example, mergers and acquisitions, which are often associated with major organizational change, may be detrimental to a firm's survival because of their congestion effects if the industry dynamics are changing.

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A potential strategy to ensure the proper functioning of the strategic issue management system is to make such a system a more permanent part of the structure of a firm's corporate strategic planning unit by recruiting dedicated staff to participate in the strategic issue management teams. While this would seem to be a relatively straightforward solution for a large globally operating firm with extensive resources, many firms are so concerned about additional overhead that they tend to weigh the costs against the benefits of on-going strategic issue management. The strategic issue management system of our case company was managed by its corporate strategy unit. Integrating the strategic issue management system with a firm's global risk management function and placing it in the strategy department might ensure the stability, sufficient resourcing, and continuous capability development needed for strategic issue management.

## References

Anderson, M.H., Nichols, M.L., 2007. Information gathering and changes in threat and opportunity perceptions. J. Manag. Stud. 44, 367–387.
Ansoff, H.I., 1975. Managing strategic surprise by response to weak signals. Calif. Manag. Rev. 18, 21–33.
Ansoff, H.I., 1980. Strategic issue management. Strateg. Manag. J. 1, 131–148.
Barnett, W.P., Freeman, J., 2001. Too much of a good thing? Product proliferation and organizational failure. Organ. Sci. 12, 539–558.
Barr, P.S., Huff, A.S., 1997. Seeing isn't believing: understanding diversity in the timing of strategic response. J. Manag. Stud. 34, 337–370.
Barr, P.S., Stimpert, J.L., Huff, A.S., 1992. Cognitive change, strategic action, and organizational renewal. Strateg. Manag. J. 13, 15–36.
Barreto, I., Patient, D.L., 2013. Toward a theory of intraorganizational attention based on desirability and feasibility factors. Strateg. Manag. J. 34, 687–703.
Bartlett, F., 1932. Remembering: a Study in Experimental and Social Psychology. Cambridge University Press, New york.
Bundy, J., Shropshire, C., Buchholtz, A.K., 2013. Strategic cognition and issue salience: toward an explanation of firm responsiveness to stakeholder concerns. Acad. Manag. Rev. 38, 352–376.
Camillus, J.C., Datta, D.K., 1991. Managing strategic issues in a turbulent environment. Long Range Plan. 24, 67–74.
Castellaneta, F., Zollo, M., 2015. The dimensions of experiential learning in the management of activity load. Organ. Sci. 26, 140–157.
Chandler, P., Sweller, J., 1991. Cognitive load theory and the format of instruction. Cogn. Instr. 8, 293–332.
Chandler, P., Sweller, J., 1992. The split-attention effect as a factor in the design of instruction. Br. J. Educ. Psychol. 62, 233–246.
Cho, T.S., Hambrick, D.C., 2006. Attention as the mediator between top management team characteristics and strategic change: the case of airline deregulation. Organ. Sci. 17, 453–469.
Christianson, M.K., Farkas, M.T., Sutcliffe, K.M., Weick, K.E., 2009. Learning through rare events: significant interruptions at the Baltimore & Ohio Railroad Museum. Organ. Sci. 20, 846–860.
Corner, P.D., Kinicki, A.J., Keats, B.W., 1994. Integrating organizational and individual information-processing perspectives on choice. Organ. Sci. 5, 294–308.
Cramton, C.D., 2001. The mutual knowledge problem and its consequences for dispersed collaboration. Organ. Sci. 12, 346–371.
Daft, R.L., Weick, K.E., 1984. Toward a model of organizations as interpretation systems. Acad. Manag. Rev. 9, 284–295.
de Jong, T., 2010. Cognitive load theory, educational research, and instructional design: some food for thought. Instr. Sci. 38, 105–134.
Dutton, J.E., Duncan, R.B., 1987. The creation of momentum for change through the process of strategic issue diagnosis. Strateg. Manag. J. 8, 279–295.
Dutton, J.E., Fahey, L., Narayanan, V.K., 1983. Toward understanding strategic issue diagnosis. Strateg. Manag. J. 4, 307–323.
Dutton, J.E., Jackson, S.E., 1987. Categorizing strategic issues - links to organizational action. Acad. Manag. Rev. 12, 76–90.
Dutton, J.E., Ottensmeyer, E., 1987. Strategic issue management-systems - forms, functions, and contexts. Acad. Manag. Rev. 12, 355–365.
Dutton, J.E., Walton, E.J., Abrahamson, E., 1989. Important dimensions of strategic issues - separating the wheat from the chaff. J. Manag. Stud. 26, 379–396.
Dutton, J.E., Webster, J., 1988. Patterns of interest around issues - the role of uncertainty and feasibility. Acad. Manag. J. 31, 663–675.
Feldman, M.S., 2000. Organizational routines as a source of continuous change. Organ. Sci. 11, 611–629.
Feldman, M.S., 2003. A performative perspective on stability and change in organizational routines. Ind. Corp. Change 12, 727–752.
Feldman, M.S., Rafaeli, A., 2002. Organizational routines as sources of connections and understandings. J. Manag. Stud. 39, 309–331.
Fraidin, S.N., 2004. When is one head better than two? Interdependent information in group decision making. Organ. Behav. Hum. Decis. Process. 93, 102–113.
George, E., Chattopadhyay, P., Sitkin, S.B., Barden, J.Q., 2006. Cognitive underpinnings of institutional persistence and change: a framing perspective. Acad. Manag. Rev. 31, 347–365.
Gilbert, C.G., 2006. Change in the presence of residual fit: can competing frames coexist? Organ. Sci. 17, 150–167.
Gregoire, D.A., Barr, P.S., Shepherd, D.A., 2010. Cognitive processes of opportunity recognition: the role of structural alignment. Organ. Sci. 21, 413–431.
Haas, M.R., Criscuolo, P., George, G., 2015. Which problems to solve? Online knowledge sharing and attention allocation in organizations. Acad. Manag. J. 58, 680–711.
Healey, M.P., Vuori, T., Hodgkinson, G.P., 2015. When teams agree while disagreeing: reflexion and reflection in shared cognition. Acad. Manag. Rev. 40, 399–422.
Hu, L., Bentler, P., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct. Equ. Model. 6, 1–55.
Hutzschenreuter, T., Kleindienst, I., 2006. Strategy-process research: what have we learned and what is still to be explored. J. Manag. 32, 673–720.
Jackson, S.E., Dutton, J.E., 1988. Discerning threats and opportunities. Adm. Sci. Q. 33, 370–387.
Jacobides, M.G., 2007. The inherent limits of organizational structure and the unfulfilled role of hierarchy: lessons from a near-war. Organ. Sci. 18, 455–477.
Janssen, J., Kirschner, F., Erkens, G., Kirschner, P.A., Paas, F., 2010. Making the black box of collaborative learning transparent: combining process-oriented and cognitive load approaches. Educ. Psychol. Rev. 22, 139–154.
Johnston, J.H., Fiore, S.M., Paris, C., Smith, C.A.P., 2013. Application of cognitive load theory to develop a measure of team cognitive efficiency. Mil. Psychol. 25, 252–265.
Joseph, J., Ocasio, W., 2012. Architecture, attention, and adaptation in the multibusiness firm: General Electric from 1951 to 2001. Strateg. Manag. J. 33, 633–660.
Julian, S.D., Ofori-Dankwa, J.C., 2008. Toward an integrative cartography of two strategic issue diagnosis frameworks. Strateg. Manag. J. 29, 93–114.
Kahneman, D., 1973. Attention and Effort. Prentice-Hall, Englewood Cliffs, NJ.
Kalyuga, S., Ayres, P., Chandler, P., Sweller, J., 2003. The expertise reversal effect. Educ. Psychol. 38, 23–31.
King, W.R., 1982. Using strategic issue analysis. Long Range Plan. 15, 45–49.
Kirschner, F., Paas, F., Kirschner, P.A., 2009a. A cognitive load approach to collaborative learning: united brains for complex tasks. Educ. Psychol. Rev. 21, 31–42.
Kirschner, F., Paas, F., Kirschner, P.A., 2009b. Individual and group-based learning from complex cognitive tasks: effects on retention and transfer efficiency. Comput. Hum. Behav. 25, 306–314.
Kirschner, F., Paas, F., Kirschner, P.A., 2011a. Task complexity as a driver for collaborative learning efficiency: the collective working-memory effect. Appl. Cogn. Psychol. 25, 615–624.
Kirschner, F., Paas, F., Kirschner, P.A., Janssen, J., 2011b. Differential effects of problem-solving demands on individual and collaborative learning outcomes. Learn. Instr. 21, 587–599.
Klein, R.B., 2011. Principles and Practice of Structural Equation Modeling, third ed. The Guilford Press, New York.

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Lampel, J., Shapira, Z., 2001. Judgmental errors, interactive norms, and the difficulty of detecting strategic surprises. Organ. Sci. 12, 599–611.
Leahy, W., Sweller, J., 2008. The imagination effect increases with an increased intrinsic cognitive load. Appl. Cogn. Psychol. 22, 273–283.
Marcel, J.J., Barr, P.S., Duhaime, I.M., 2011. The influence of executive cognition on competitive dynamics. Strateg. Manag. J. 32, 115–138.
Markoczy, L., 2001. Consensus formation during strategic change. Strateg. Manag. J. 22, 1013–1031.
McMullen, J.S., Shepherd, D.A., Patzelt, H., 2009. Managerial (in)attention to competitive threats. J. Manag. Stud. 46, 157–181.
Miller, G.A., 1956. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychol. Rev. 63, 81–97.
Muthén, L.K., Muthén, B.O., 2012. Mplus User's Guide, seventh ed. Muthén & Muthén.
Nadkarni, S., Barr, P.S., 2008. Environmental context, managerial cognition, and strategic action: an integrated view. Strateg. Manag. J. 29, 1395–1427.
Nunnally, J., 1978. Psychometric Theory. McGraw-Hill, New York.
Ocasio, W., 1997. Towards an attention-based view of the firm. Strateg. Manag. J. 18, 187–206.
Ocasio, W.P., Joseph, J., 2006. Governance channels and organizational design at General Electric: 1950-2001. In: Eriksen, B., Burton, R., Håkonsson, D.D. (Eds.), Organization Design: the Dynamics of Adaptation and Change and the Evolving State-of-the-art.
Oomens, M.J.H., van den Bosch, F.A.J., 1999. Strategic issue management in major European-based companies. Long Range Plan. 32, 49–57.
Paas, F., Renkl, A., Sweller, J., 2004. Cognitive load theory: instructional implications of the interaction between information structures and cognitive architecture. Instr. Sci. 32, 1–8.
Peng, L., Xiong, W., 2006. Investor attention, overconfidence and category learning. J. Financ. Econ. 80, 563–602.
Pina e Cunha, M., Clegg, S.R., Kamoche, K., 2005. Surprises in management and organization: concept, sources and a typology. Br. J. Manag. 16, 1–13.
Plambeck, N., Weber, K., 2009. CEO ambivalence and responses to strategic issues. Organ. Sci. 20, 993–1010.
Ren, Y., Argote, L., 2011. Transactive memory systems 1985–2010: an integrative framework of key dimensions, antecedents, and consequences. Acad. Manag. Ann. 5, 189–229.
Renkl, A., Hilbert, T., Schworm, S., 2009. Example-based learning in heuristic domains: a cognitive load theory account. Educ. Psychol. Rev. 21, 67–78.
Rerup, C., 2009. Attentional triangulation: learning from unexpected rare crises. Organ. Sci. 20, 876–893.
Salazar, M.R., Lant, T.K., Fiore, S.M., Salas, E., 2012. Facilitating innovation in diverse science teams through integrative capacity. Small Group Res. 43, 527–558.
Schneider, S.C., Demeyer, A., 1991. Interpreting and responding to strategic issues - the impact of national culture. Strateg. Manag. J. 12, 307–320.
Stark, R., Gruber, H., Renkl, A., Mandl, H., 1998. Instructional effects in complex learning: do objective and subjective learning outcomes converge? Learn. Instr. 8, 117–129.
Steiger, J., 2007. Understanding the limitations of global fit assessment in structural equation modeling. Pers. Individ. Differ. 42, 893–898.
Stevens, R., Moray, N., Bruneel, J., Clarysse, B., 2015. Attention allocation to multiple goals: the case of for-profit social enterprises. Strateg. Manag. J. 36, 1006–1016.
Sweller, J., 1976. Effect of task complexity and sequence on rule learning and problem-solving. Br. J. Psychol. 67, 553–558.
Sweller, J., 1980. Hypothesis salience, task-difficulty, and sequential effects on problem-solving. Am. J. Psychol. 93, 135–145.
Sweller, J., 1988. Cognitive load during problem-solving - effects on learning. Cogn. Sci. 12, 257–285.
Sweller, J., 2004. Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. Instr. Sci. 32, 9–31.
Sweller, J., Chandler, P., 1991. Evidence for cognitive load theory. Cogn. Instr. 8, 351–362.
Sweller, J., Chandler, P., 1994. Why some material is difficult to learn. Cogn. Instr. 12, 185–233.
Sweller, J., Chandler, P., Tierney, P., Cooper, M., 1990. Cognitive load as a factor in the structuring of technical material. J. Exp. Psychol. Gen. 119, 176–192.
Sweller, J., Mawer, R.F., Howe, W., 1982. Consequences of history-cued and means-end strategies in problem-solving. Am. J. Psychol. 95, 455–483.
Sweller, J., van Merrienboer, J.J.G., Paas, F., 1998. Cognitive architecture and instructional design. Educ. Psychol. Rev. 10, 251–296.
Thomas, J.B., Clark, S.M., Gioia, D.A., 1993. Strategic sensemaking and organizational performance - linkages among scanning, interpretation, action, and outcomes. Acad. Manag. J. 36, 239–270.
Thomas, J.B., McDaniel, R.R., 1990. Interpreting strategic issues - effects of strategy and the information-processing structure of top management teams. Acad. Manag. J. 33, 286–306.
Thomas, J.B., Shankster, L.J., Mathieu, J.E., 1994. Antecedents to organizational issue interpretation - the roles of single-level, cross-level, and content cues. Acad. Manag. J. 37, 1252–1284.
Thomas, J.B., Trevino, L.K., 1993. Information-processing in strategic alliance building - a multiple-case approach. J. Manag. Stud. 30, 779–814.
van der Steen, M., 2016. Managing bottom up strategizing: collective sensemaking of strategic issues in a Dutch bank. Long Range Plan. http://dx.doi.org/10.1016/j.lrp.2016.02.003 (in press).
van Merrienboer, J.J.G., Sweller, J., 2005. Cognitive load theory and complex learning: recent developments and future directions. Educ. Psychol. Rev. 17, 147–177.
Wegner, D.M., Giuliano, T., Hertel, P.T., 1985. Cognitive interdependence in close relationships. In: Ickes, W. (Ed.), Compatible and Incompatible Relationships. Springer New York, New York, NY.
Weick, K.E., 1993. The collapse of sensemaking in organizations - the Mann Gulch disaster. Adm. Sci. Q. 38, 628–652.
Wooldridge, B., Floyd, S.W., 1990. The strategy process, middle management involvement, and organizational performance. Strateg. Manag. J. 11, 231–241.
Yun, R.J., Krystal, J.H., Mathalon, D.H., 2010. Working memory overload: fronto-limbic interactions and effects on subsequent working memory function. Brain Imaging Behav. 4, 96–108.

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